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Fertility Differences between Silvofishery Pond and Conventional Pond in Legonkulon, Subang District, Indonesia

Asep Sahidin[1,2,*], Zahidah[2], Nia Kurniawati[2], Heti Herawati[2], Achmad Rizal[2]

[1]Head of Aquatic Resources Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Indonesia

[2]Department of Fisheries, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Indonesia

*E-mail address: syahid1104@gmail.com

ABTRACT

This study was conducted to determine the fertility difference between silvofishery pond and conventional pond in Legonkulon, Subang, West Java. Sampling methods was used by collecting samples four times in the composite from five sampling points at six stations (three stations at silvofishery ponds and three stations at conventional ponds). The data were analyzed with comparative descriptive method. The results showed that average abundance of phytoplankton in the silvofishery pond is higher (1935 ind/l) than in the conventional pond (494 ind/l). Average abundance of zooplankton in the silvofishery pond found lower (383 individuals/L) than conventional pond (963 ind/l). Makrozoobenthos average abundance is not significantly different between silvofishery pond and conventional pond with average abundance of each 1162 and 1306 individuals/m^2 respectively. Silvofishery pond with a composition of 20% mangrove and 80% ponds increased fertility of plankton and makrozoobenthos.

***Keywords*:** Fertility, Makrozoobentos, Plankton, Pond, Silvofishery, Subang District

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1. INTRODUCTION

Pond fertility is strongly influenced by physical conditions, water chemistry and substrate which is the result of decomposition of organic matter that enters the pond. The input of organic material is an important part of the organic transfer from vegetation into ponds. Nutrients produced from the decomposition process in the soil are very important as a detritus source for marine and estuary ecosystems in supporting the life of various aquatic organisms such as macrozoobenthos and plankton.

Fertility levels of plankton and macrozoobenthos in ponds are strongly influenced by several physical factors, water chemistry and substrate quality [1]. The physical parameters that influence are the temperature and transparency of the pond, while the chemical parameters that can influence are acidity (pH), salinity, dissolved oxygen (DO), BOD, nitrate and phosphate. nitrogen, potential phosphorus and C/N ratio [2] [3]. Increased fertility of plankton and macrozoobenthos will increase natural feed in ponds. Macrozoobenthos has an important role in the nutrient cycle and food chain cycle [4] [5]. Polychaeta is macrozoobenthos which can be used as an indicator of the presence of organic matter [6-8], whereas organic matter is an important factor in pond fertility.

Legonkulon is one of the lowland area in Subang District which is in the northern coastal area with an area of 6.543.395 Ha which is divided into 7 villages including Legonkulon, Pangarengan, Legonwetan, Tegalurung, Mayangan and Karang mulya villages are villages the coast that produces fish through pond activities. Tegalurung including the village with the largest pond reaches 322.0 Ha. The ponds are spread between residential areas to mangrove forests using two management namely conventional ponds (ponds without mangrove trees) and silvofishery ponds (ponds collaborated with mangrove plants). The purpose of this study was to determine differences in fertility between silvofishery ponds and conventional ponds in Legonkulon Subang District.

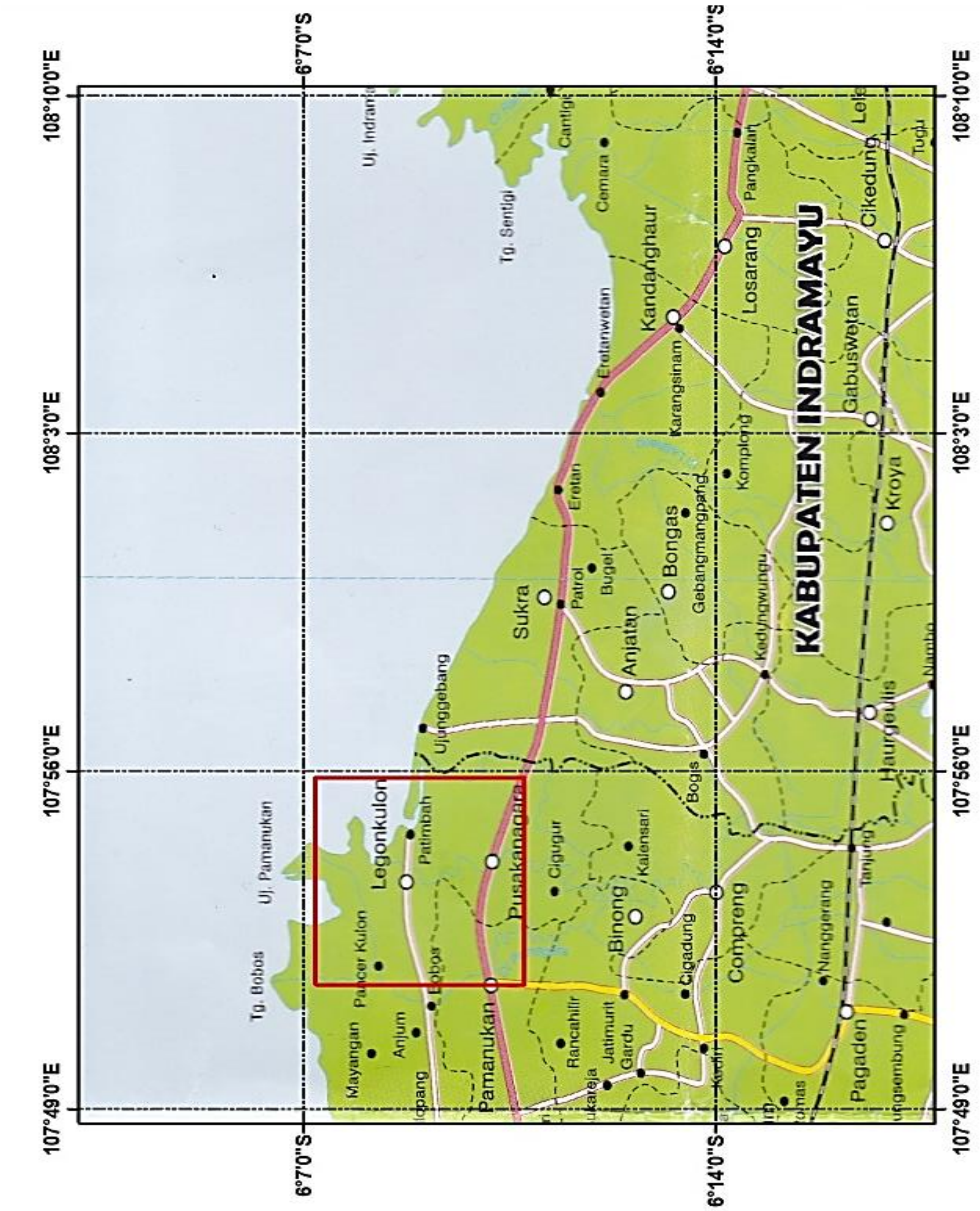
2. MATERIAL AND METHOD

2. 1. Study site

The research was carried out in a pond in the Legonkulon, Subang District, West Java, Indonesia (Map 1). Plankton samples were taken by purposive sampling with 3 replications at 6 stations. The research station was divided into 2 locations, namely the location of the silvofishery pond (SL1, SL2, and SL3) and the location of a conventional pond (SL4, SL5 and SL6), stations were explained as follows:

SL1 = silvofishery ponds at 80-20 (80% mangrove plant and 20% ponds),
SL2 = silvofishery ponds at 60-40 (60% mangroves plant and 40% ponds),
SL3 = silvofishery ponds at 20-80 (20% mangrove plant and 80% ponds) and
SL4 = Conventional ponds (0% mangrove plant and 100% ponds)
SL5 = Conventional ponds (0% mangrove plant and 100% ponds)
SL6 = Conventional ponds (0% mangrove plant and 100% ponds)

Plankton samples were taken at 5 points per station composite using net plankton with a mesh size of 60 μm and a mouth diameter of 30 cm by 20 liters. Plankton samples were put on a 30 ml colector bottle. Benthos is taken at the same point by using Veen Van grab with an opening tool of 0.04 m^2.



Map 1. Legonkulon, Subang District, West Java, Indonesia.

2. 2. Parameter and Data Analysis

Physical-chemical parameters of water quality include temperature, pH, DO, transparency and salinity measured in situ, while the parameters BOD, NO_3-N, PO_4-P and biology parameters are measured ex situ at the MSP Laboratory of the Faculty of Fisheries and Marine Sciences, Padjadjaran University. Sediment quality are meansured at the Faculty of Agriculture, Padjadjaran University. The results of the measurement parameters obtained were tabulated as a whole then analyzed by quantitative ecological methods to find out the differences in a descriptive comparative.

3. ADDITIONAL FERTILITY IN LEGONKULON, SUBANG DISTRICT

3. 1. Water Quality

Water quality measured includes physical parameters, namely temperature and transparency, and chemical parameters, namely salinity, pH, DO, BOD, Nitrate and Phosphate (Tab. 1).

Table 1. Water quality parameters at site sampling location.

Parameters	Station					
	SL1	SL2	SL3	SL4	SL5	SL6
Physical parameters						
Temperature (°C)	27,3-29,3	27-28,5	28,9-29,5	28,5-30	30-32	29,5-32
Transparency (cm)	35-41	35-47	35-40	43-63	30-32	17-25
Chemical parameters						
Salinity (°/oo)	5-15	9-23	10-22	11-19	5-18	2-11
pH	6,4-8,9	6,9-8,7	6,6-8,9	6,8-8,7	7,6-9,9	7,6-10,0
DO (mg/l)	4,1-4,2	5,9-10,1	4,9-9,1	6,3-7,6	6,7-9,1	8,3-11,0
BOD (mg/l)	4,9-8,0	3,3-6,5	5,5-8,9	3,3-7,5	4,1-6,5	11,0-13,8
Nitrate (mg/l)	0,46-0,76	0,33-0,66	0,36-0,4	0,29-0,83	0,23-0,36	0,42-0,56
Phosphate (mg/l)	0,05-0,08	0,06-0,08	0,04-0,06	0,05-10	0.05-0,13	0,07-0,11

Parameters of salinity, pH and DO in silvofishery ponds and conventional ponds did not differ significantly, while the BOD parameters in conventional ponds were higher with a range of 3.3-13.8 mg / l compared to silvofishery ponds with a value of 3.3-8.9 mg / l. The temperature parameters have different values between silvofishery ponds 27.0-29,50C and conventional ponds with a value range of 28.5-320C. Viewed from the potential phosphorus of conventional ponds has a higher percentage of the range 10.02-24.92% compared with silvofishery ponds with a range of 9.70-12.90%.

The results of measurements of water quality show that the temperature greatly affects the solubility of O_2 in the waters. The drop in water temperature increases the capacity to dissolve O_2 rather than in high temperature conditions. The temperature in silvofishery ponds and conventional Legonkulon ponds in Subang Regency found not much different from the range of 27.3-32 ºC and still in the optimum temperature for the growth of aquatic organisms [3]. States that phytoplankton and benthos are able to develop well at temperatures >25 ºC.

The temperature in silvofishery ponds has a relatively small range compared to conventional ponds. This shows that mangrove plants act as a regulator of the intensity of sunlight entering the pond. The BOD in conventional ponds is higher than the silvofishery pond, because conventional ponds are close to settlements so there is a lot of organic waste entering the pond. However, measurements of salinity, pH and DO in silvofishery ponds and conventional ponds are not much different.

The concentration of nitrate and phosphate in silvofishery ponds is lower than conventional ponds, because conventional ponds are closer to settlements so there is a lot of organic waste that can increase the concentration of nitrate and phosphate. This shows that anthropogenic activities play a greater role in increasing nutrients in the aquatic environment.

3. 2. Sediment Quality

Sediment quality includes organic carbon, total nitrogen, potential phosphate, C/N ratio and sediment texture (Table 2), each station has a dominance of clay texture. Based on the texture analysis of the substrate in Legonkulon, it is good for aquaculture activities. This is in same with the statement [9], the soil structure that is very suitable for ponds is the medium type with fine sandy clay texture, or dusty clay to the fine type with a type of sandy clay or dusty clay. Whereas coarse-type soil is not very good for pond texture. The level of clay (permeability) of the pond substrate is made as a strength in making embankments on ponds. Factors that cause differences in substrate pond are domestic waste, agricultural waste and alloktan that enter into cultivation sites which are dominated by microbial organisms [10].

Viewed from the potential phosphorus of conventional ponds has a higher percentage of the range 10.02-24.92% compared with silvofishery ponds with a range of 9.70-12.90%. This is because in addition to the level of plasticity of the pond substrate is also due to the source of phosphorus, which is residential waste, because conventional ponds are closer to the settlement [11. States that the natural source of phosphorus in waters comes from weathering of mineral rocks and the results of decomposition of organic matter and externally derived from human activities such as domestic and agricultural waste.

Table 2. Sediment quality parameters at site sampling location.

Parameters	Station					
	SL1	**SL2**	**SL3**	**SL4**	**SL5**	**SL6**
C Organic (%)	1,04	1,65	1,62	1,03	1,11	1,03
N Total (%)	0,22	0,28	0,25	0,19	0,22	0,21
Phosphorus (mg/100g)	12,90	9,70	13,77	16,68	10,02	24,92
C/N Ratio	7	6	6	5	5	5
Textur	clay	sand clay	sand clay	sand clay	sand clay	sand clay

The presence of organic carbon (C-organic) is greater in silvofishery ponds with a percentage of 1.04-1.65% compared to conventional ponds with a percentage of only 1.03-1.11%. Likewise, the percentage of total nitrogen (N) at each station has a different percentage but is relatively small. The percentage of nitrogen in silvofishery ponds was higher, namely the range 0.22-0.28% compared to conventional pond ranging from 0.19 to 0.22%. The concentration of organic matter in the sediment determines the state of C and N in the pond. According to [12] organic matter is a reservoir or nitrogen element reservoir which is sedimented at the bottom of the water.

3. 3. Biotic Parameters

Composition and abundance of plankton

The result of plankton and benthos to silvofishery pond and conventional pond in Legonkulon, Subang District West Java presented significant difference (Tables 2 & 3). Identified plankton found to 15 classes. Phytoplankton consists of 9 classes, namely Bacillariophyceae, Charophyceae, Chlorophyceae, Coscinodiscophyceae, Dinophyceae, Fragilariophyceae, Nostocophycideae, Prostomatea dan Zignematophyceae. While zooplankton consists of 6 classes, namely Adenophorea, Branchiopoda, Bdelloidae, Maxillopoda, Magnaliopsida, dan Monogonta.

The composition of plankton genera (Table 2) found 33 genera to all station. The composition genera presented of phytoplankton more higher with zooplankton genera. The number of genera included in phytoplankton is 23 genera while the genus included in zooplankton are 10 genera. That is because Legonkulon ponds are located in lowland areas and have a goog light penetration. Light penetration very important for the growth of phytoplankton [13].

Classes of Bacillariophyceae found existence dominates the types of phytoplankton identified. This is due to the fact that Legonkulon ponds are generally from the result of measurements of physical and chemical parameters both for the growth of the Bacillariophyceae class. Navicula genera from Bacillariophyceae classes found to all station with abundance 94 ind/l. Bacillariophyceae is a phytoplankton have a ability good photosynthesis and it's phytoplankton tolerance to organic pollution, salinity, temperature, nutrient enrichment and light [13, 14].

The stations of SL2 and SL3 have the highest abundance of phytoplankton, which is 4444 ind/l, thus indicating a high fertility rate compared to other stations. SL1 stations although in the form of silvofishery land has a low phytoplankton abundance of 302 ind/l, because in this station have mangroves up to 80% of the pond area thus blocking sunlight penetration the pond, this is due to of phytoplankton growth to be not optimal. This statement is in line with research [15], the lack of silvofishery with empang parit models, have a more mangrove plant in around pond, so that sunlight penetration the pond surface more low, the effect from photosynthesis of phytoplankton to be not optimal.

The lowest abundance of phytoplankton is at SL6 station which is 199 ind/l, this is because SL6 stations have the lowest transparency compared to other stations which value 17-25 cm, because it is the closest station to the settlement, so there is a lot of organic matter and waste entering the ponds that will reduce the level of transparency in the aquaculture. This condition is in line with the statement [16] that transparency is influenced by colloidal particles and organic suspension which will limit phytoplankton photosynthesis in the waters.

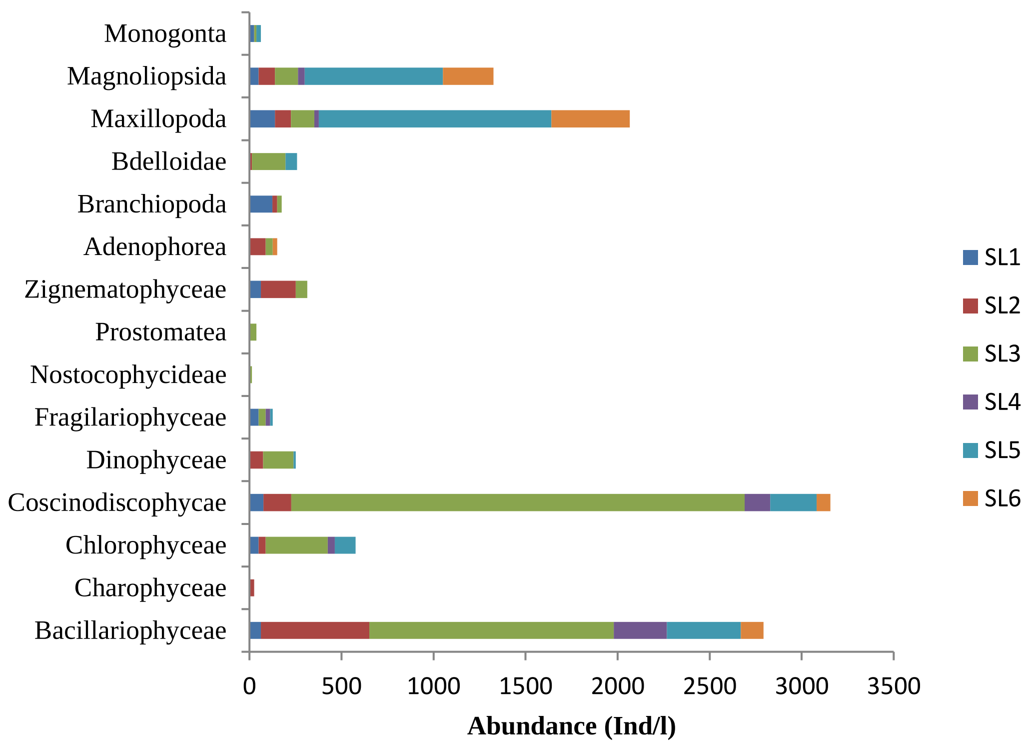


Fig. 2. Abundance of phytoplankton each classes

Table 2. Abundance of phytoplankton each genera.

Genera	Station (ind/l)*					
	SL1	SL2	SL3	SL4	SL5	SL6
Phytoplankton						
Ceratium	-	25	13	-	-	-
Cymbella	-	-	38	-	-	-
Clostterium	-	25	-	-	-	-
Coconois	-	-	63	-	-	-
Dactyliosolea	-	-	13	38	-	-
Gyrodinium	-	-	63	-	-	-
melosira	13	-	13	-	13	-
Navicula	63	63	225	88	100	25
Nostoc	-	-	13	-	-	-
Lepcylindrus	-	13	25	-	13	13

Oscilatoria	50	25	325	38	113	-
Pandorina	-	-	13	-	-	-
pediastrum	-	13	-	-	-	-
Pleurosygma	-	513	963	163	288	86
Prorosentrum	-	-	75	-	13	-
Prorodon	-	-	38	-	-	-
Pyrosystis	-	50	13	-	-	-
Rhizosolenia	25	38	75	75	113	-
Skeletonema	-	-	-	-	13	-
Spirogyra	63	188	63	-	-	-
Surirella	-	63	13	-	-	-
Thalasiossira	-	38	2375	63	113	75
Thalassiotrix	50	-	38	25	13	-
Zooplankton						
Acartya	62	25	13	-	763	363
Branchionus	25	-	13	-	25	-
Calanus	-	-	13	25	-	25
Cyclops	50	-	-	-	-	-
Macrosetella	25	63	100	-	500	38
Moina	125	25	25	-	-	-
Nauplii	50	88	125	38	750	275
Philodina	-	12,5	183	-	63	-
Rhabdolaimus	-	86	38	-	-	25

Composition and abundance of macrozoobenthos

The abundance of the average macrozoobenthos at SL3, SL2 and SL1 stations decreased (Tab. 3). The decrease was estimated to be the percentage of mangrove plants in ponds, this is in accordance with research [15] that mangrove plants in addition to producing organic matter as a basic ingredient in macrozoobenthos food also produce tannins which are negative for macrozoobenthic life. In addition, the mangrove plants reduce the intensity of sunlight into the ponds, the thicker the mangrove plants the less the intensity of the light that enters the pond [17].

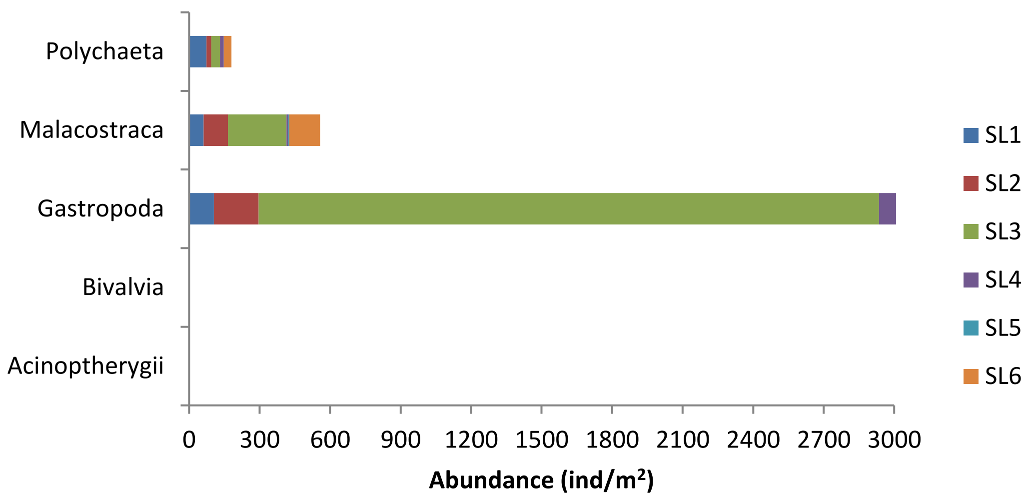


Fig. 3. Abundance of mmacrozoobenthos each station

The benthic parameters were found in 13 genera which were divided into 5 classes, namely the class of Acinopthergii, Bivalve, Gastropods, Malacostraca and Polychaeta (Fig. 3). Gastropod classes are identified as 5 genera and are found to dominate at each station. This is because the aquaculture has a mud substrate that is favored by Gastropod class life. In accordance with [25] statement that Gastropoda is an organism that has a wide range of spread on rocky, sandy and muddy substrates, but these organisms tend to like sand or muddy substrate. The composition of the average abundance of macrozoobenthos of conventional ponds is higher than that of silvofishery ponds although there is not too much difference. The average abundance of macrozoobenthos of silvofishery ponds was 1162 ind/m^2, while the average abundance of macrozoobenthos in conventional ponds was 1306 ind/ m^2. This is because the area of mangrove with ponds and the amount of litter that goes into the pond. This is in line with the research [15] in addition to producing organic matter as a basic ingredient of macrozoobenthos food, it also produces acidic tannins which will interfere with the life of macrozoobenthos. In addition, mangrove plants reduce the intensity of sunlight into the ponds, the thicker the mangrove plants the less the intensity of light entering the pond.
Station of SL1 has the highest total abundance with a value of 2926 Ind/m^2 dominated by Gastropod class with an abundance of 2640 Ind/m^2 and Malacostraca classes with an abundance of 250 ind/m^2. Whereas Station of A1 has the lowest total abundance of 243 ind/m^2 which is dominated by Gastropoda and Polycaeta with abundance of 105 ind/m^2 and 74 ind/m^2.

Table 3. Abundance of macrozoobenthos each genera

Genus	**Stasiun (ind/m^2)**					
	SL1	**SL2**	**SL3**	**SL4**	**SL5**	**SL6**
Ampelisca	60	94	215	4	1	128
Callirectec	1	-	-	-	-	-

Glycera	1	-	-	-	-	-
Monopterus		-	-	-	-	1
Peryglipta	1	-	-	1	-	
Nereis	73	21	36	16		33
Sermyla	-	30	**2506**	748	821	823
Sterothyra	69	-	-	-	-	-
Telina	1	-	-	-	-	-
Tanais	1	9	35	3	3	4
Terebralia	36	160	134	610	713	13
Telescopium	-	1	-	-	-	-
Theodoxus	-	-	-	-	1	-

The Gastropoda and Malacostraca classes not only dominate the SL1 station but also dominate the SL2, SL4, SL5 and SL6 stations compared to the Polychaeta, Bivalvia and Acynoptherygii classes. These results are in accordance with the statement [18] that Crustacea and Gastropoda are mangrove fauna with extensive distribution. So that the class is easily found in various stations and the concentration level of organic matter and the type of substrate determines the presence of these macrozoobenthos. According to [19] the dominance of Gastropoda class due to the nature of Gastropods living in a cluster, uniform and sticking all the time, besides research [20] states the macrozoobenthos community has specific adaptations to environmental and ecological conditions to be able to live, grow and reproduce.

The abundance of the average Malacostraca class at SL4 and SL5 stations is only 7 ind/m^2 and 4 ind/m^2 are much lower compared to other stations. This is because the station is a conventional farm located far from the residential area so that the supply of organic material into the pond is lacking. According to [21] benthic organisms require organic matter as a food source.

3. 4. Differance in shrim pond fertility

Kesuburan tambak menjadi salah satu faktor penting untuk peningkatkan produktivitas perikanan tambak. Parameter kesuburan meliputi faktor biologi, fisik air, kimiawi air, dan kualitas sedimen. Sehingga pada penelitin ini akan membandingkan tambak silvofisheries (stasiun SL1, Sl2 dan SL3) dan tambak konvensional (stasiun SL4, SL5 dan SL6) (Table 4).

The measurement results showed that the percentage of C and N organic in silvofishery ponds was higher compared to conventional ponds, this was in line with the statement [13] that mangrove plants could produce organic material from their handover which would then be decomposed by decomposer organisms. The measurement results of pond substrate for each station showed a small C/N ratio. According to [2] a land with a low C/N ratio tends to contain organic material which is easily decomposed, whereas at high C/N organic matter decomposes very slowly. This shows that mangrove litter is a source of oganganic material that is easily decomposed.

Table 4. Perbedaan Kelimpahan Biota pada Tambak Silvofishery dan Tambak Konvensional.

Parameters	**Silvofishery ponds***	**Conventional ponds****
Biology		
Phytoplankton (ind/l)	1938	494
Zooplankton (ind/l)	383	963
Macrozoobenthos (ind/m^2)	1162	1306
Water Physical		
Temperature (ºC)	27,3 - 31,5	28,5 – 32
Transparancy (cm)	35 – 47	17 – 63
Water Chamistery		
Salinity	5 – 23	2 – 19
pH	6,4 - 8,9	6,8 – 10
DO (mg/l)	4,1 – 10,1	6,3 – 11,0
BOD (mg/l)	3,3 – 8,9	3,3 – 13,8
Nitrate (mg/l)	0,33 – 0,76	0,23 – 0,83
Phospate (mg/l)	0,04 – 0,08	0,05 – 0,13
Sediment Quality		
C Organik (%)	1,04 – 1,65	1,03 -1,11
N Total (%)	0,22 – 0,28	0,19 – 0,22
C/N	5-6	5
Tekstur	Sand clay	Sand clay

Note: *Silvofishery pond (average of the SL1, SL2, SL3 station) and **Conventional pond (average of the SL4, SL5, SL6 station).

The presence of organic carbon (C) is greater in silvofishery ponds with a percentage of 1.04-1.65% compared to conventional ponds with a percentage of only 1.03-1.11%. Likewise, the percentage of total nitrogen (N) at each station has a different percentage but is relatively small. The percentage of N in silvofishery ponds was higher, namely the range 0.22-0.28% compared to conventional ponds ranging from 0.19 to 0.22%. Based on carbon and nitrogen measurements, the C/N ratio of silvofishery ponds was higher with an average of 6.1 compared to C/N ratio in conventional ponds with a value of 5.

Based on Tab. 4, the abundance of the average phytoplankton in silvofishery ponds is greater, namely 1938 ind/l compared to conventional ponds which are 494 ind/l. The Coscinodiscophyceae class dominated the silvofishery pond with an average abundance of 897 ind/l with the dominance of the genus Thalasiossira which was 804 ind/l, followed by the Bacillariophyceae class with an average abundance of 660 ind/l and the predominance of the Pleurosygma genera, 492 ind/l. whereas in conventional farms it is dominated by the Bacillariophyceae class with an average abundance of 272 ind/l with the predominance of the Pleurosygma genus which is 178 ind/l.

The average abundance of phytoplankton in silvofisheries ponds with a composition of 80% mangrove plant and 20% of ponds shows the lowest abundance of phytoplankton, because sunshine does not optimally enter the ponds which causes photosynthesis in low phytoplankton In accordance with the study [22], silvofishery ponds with high percentage of mangroves resulted in the obstruction of sunlight entering the pond surface which caused low sunlight intensity as phytoplankton photosynthetic energy sources. Unlike the case with silvofishery ponds with a mangrove composition composition of 20% and 80% ponds, the highest plankton abundance was 4444 ind/l.

The stations in conventional farms during the study found relatively little abundance of phytoplankton, which was thought to be due to conventional ponds receiving very high sunlight resulting in photoinhibition and experiencing high temperature fluctuations. So that the phytoplankton development is not optimum.

The average abundance of zooplankton in silvofishery ponds was lower at 383 ind/l compared to conventional ponds which were 963 ind/l. Station SL2 has the highest average abundance of 2101 ind/l because station SL2 is a conventional pond close to the settlement so it supplies organic material from high rivers. At SL3 station, although it is a conventional pond closest to the settlement, it has an abundance of zooplankton lower than SL2 station, it is suspected that pollutants besides many organic materials enter the pond. Zooplankton abundance is more dominant in conventional ponds with an abundance of 963 ind/l compared to silvofishery ponds with an abundance of 383 ind/l. Maxillopoda class dominates both silvofishery and conventional ponds with an abundance value of 117 ind/l and 517 ind/l, respectively. It is suspected that during the study, zooplankton in silvofishery ponds were at the lowest point in the cyclic cycle of phytoplankton and zooplankton.

The highest abundance of macrozoobenthos was found in silvofishery ponds with an extensive composition of 20% mangroves and 80% ponds with a value of 2926 ind/m^2 dominated by Gastropod 2640 Ind/m^2 class and Malacostraca class 250 Ind/m^2. On the other hand, on silvofishery ponds with an 80% extensive composition of mangroves and 20% ponds, the lowest average abundance was 243 ind/m^2 which were dominated by Gastropoda and Polycaeta with abundance of 105 ind/m^2 and 74 ind/m^2 respectively.

The average abundance of macrozoobenthos of silvofishery ponds is 1162 ind/m^2 dominated by Gastropod class with an average abundance value of 979 ind/m^2, while the average abundance of macrozoobenthos in conventional ponds is 1306 ind/m^2 and Gastropoda classes also dominate with average abundance 1243 Ind/m^2. Gastropods have a distribution in mud sediments and have relatively high organic concentrations [23] [24].

4. CONCLUSION

Based on Biological measurements, water quality and substrate on silvofishery ponds and conventional ponds in Legonkulon Subang District, fertility in silvofishery ponds was higher compared to conventional ponds. Silvofishery ponds with an extensive composition of 20% mangroves and 80% ponds have the highest fertility.

Reference

[1] Nybakken J.W & M.D. Bertness. 2005. Marine Biology: An Ecological Approach. Edisi ke 3. New York: Pearson Benjamin Cummings.

[2] Boyd, C.E., Wood, C.W., and T. Thunjai. 2001. *On- the- Gound Uses of CRSP Pond Soil Research Results.* Pond Dynamic/Aquaculture CRSP Aquanews – Fall, 2001.

[3] Unuoha PC, Nwankwo DI, Chukwu LO, Wim V (2011). Spatio-temporal variations in phytoplankton biomass and diversity in a tropical eutrophic lagoon, Nigeria. *J Am Sci* 7(8): 33–46.

[4] Sahidin A, Isdradjad S, Y Wardiatno. 2014. Macrozoobentos Community Structures of Tangerang Coastal Water, Banten. *Depik*, 3(3): 226-233.

[5] Wardiatno Y, Y Qonita, Mursalin, R Zulmi, H Effendi, M Krisanti, A Mashar, S Hariyadi, AA Hakim, A Sahidin, B Widigdo, S Nursiyamah. 2017. Determining ecological status of two coastal waters in Western Java using macrozoobenthic community: A comparison between North Part and South Part. *IOP Conf Ser: Earth Environ Sci* 54 (1): 01207.

[6] Lu, L. 2005. The Relationship between soft bottom macrobenthic communities and environmental variables in Singaporean waters. *Marine Pollution Bulletin* 51: 1034-1040.

[7] Gholizadeh, M., A. Yahya, A. Talib & O. Ahmad. 2012. Effects of environmental factors on polychaete assemblage in Penang National Park, Malaysia. *Word Academy of Science, Engineering and Technology Journal* 72: 669-672.

[8] Sahidin A, Y. Wardiatno. 2016. Spatial distribution of Polychaete at Tangerang coastal water, Banten Province. *J Fish Mar* 6 (2): 83-94.

[9] Christensen, B., A. Vedel & E. Kristensen, 2000. Carbon and nitrogen fluxes in sediment inhabited by suspensionfeeding (Nereis diversicolor) and non-suspension-feeding (N-virens) polychaetes. *Marine Ecology Progress Series* 192: 203-217.

[10] Taketani R.G., N.O. Franco, A. S. Rosado, J.D. van Elsas. 2010. Microbial community response to a simulated hydrocarbon spill in mangrove sediments. *The Journal of Microbiology*, 48(1): 7-15.

[11] Lovelock C.E., I.C. Feller, J. Ellis, A.M. Schwars, N. Hancock, P. Nichols, B. Sorrell. 2007. Mangrove growth in New Zealand estuaries: the role of nutrient enrichment at sites with contrasting rates of sedimentation. *Oecologia*, 153: 633-641.

[12] Riyadi AS, Itai T, Isobe T, Ilyas M, Sudaryanto A, Setiawan I., Tahahashi S. 2012. Spatial Profile of Trace Elements in Marine Sediments from Jakarta Bay, Indonesia. *Interdisciplinary Studies on Environmental Chemistry - Environmental Pollution and Ecotoxicology*, 6,141-150.

[13] El-Sheekh MM, Deyab MAI, Desouki SS, Eladl M (2010) Phytoplankton compositions as a response of water quality in El Salam canal, Hadous drain and Damietta branch of River Nile, Egypt. *Pak J Bot* 42(4): 2621-2633.

[14] Szczerbinska N, M. Galczynska. 2015. Biological methods used to assess surface water quality. *Arch. Pol. Fish.* 23: 185-196.

[15] Maznah W.O.W., A. Makhlough. 2015. Water quality of tropical reservoir based spatio-temporal variation in phytoplankton composition and physico-chemical analysis. *International Journal Environment Science Technology*, 12: 2221-2232.

[16] Gilman E L, J E Ellison, N C Duke dan C Field, 2008. Threats to mangroves from Climate Change and Adaptation Options: A Review. *Journal Aquatic Botany* 89: 237-250.

[17] Tolhurst T.J. 2009. Weak diurnal changes in the biochemical properties and benthic macrofauna of urbanised mangrove forests and mudflats. *Hydrobiologia*, 636: 101-117.

[18] Yolanda R., Syaifullah S., Nurdin J., Febriani Y., Muchlisin Z. A., 2015 Diversity of gastropods (Mollusc) in the mangrove ecosystem of the Nirwana coast, Padang City, West Sumatra, Indonesia. *AACL Bioflux* 8(5): 687-693.

[19] Irma D., K Sofyatuddin. 2012. Diversity of gastropods and bivalves in mangrove ecosystem rehabilitation areas in Aceh Besar and Banda Aceh districts, Indonesia. *AACL Bioflux* 5(2): 55-59.

[20] Wardiatno Y, Mardiansyah, T Prartono and M Tsuchiya. 2015. Possible food sources of macrozoobenthos in the Manko Mangrove Ecosystem, Okinawa (Japan): A stable isotope analysis approach. *Tropical life science research* 26(1): 53-65

[21] Wibowo DN, Setijanto, Santoso S. 2017. Short communication: Benthoc macroinvertebrate diversity as biomonitoring af organic pollutions of river ecosystems in Central Java, Indonesia. *Biodiversitas* 8(2): 671-676.

[22] Rumahlatu D., Leiwakabessy F. 2017. Biodiversity of gastropoda in the coastal waters of Ambon Island, Indonesia. *AACL Bioflux* 10(2): 285-296.

[23] Manoharan J, Varadharajan D, Thilagavathi B, Priyadharsini S. 2011. Biodiversity and abundance of benthos along the South East Coast of India. *Advances in Applied Science Research* 2: 554-562.

[24] Sahidin A, Zahidah, H Herawati, Y Wardiatno and I Setyobudiandi. 2018. Macrozoobenthos as bioindicator of ecological status in Tanjung Pasir Coastal, Tangerang District, Banten Province, Indonesia. *Biodiversitas*, 19(3): 1123-1129.

[25] Manoharan, J., D. Varadharajan, B. Thilagavathi, S. Priyadharsini. 2011. Biodiversity and abundance of benthos along the South East Coast of India. *Advances in Applied Science Research* 2(6): 554-562.